Space Weather Technical Forecast

Issued on Monday, 07 November 2022 at 13:01 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight chance of G1/minor storms. Chance of M-class flares (R1; Minor radio blackouts) throughout. Active fluence (1e8 integrated pfu) likely through much of the period.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate, with several C-class flares observed in the past 24 hours, and at 07/0011UTC a single M-class flare was recorded originating from sunspot AR3141. There are five numbered and one unnumbered active regions on the visible disc. AR3141 in the east remains the largest and most complex, classified Eko/Beta, this spot has shown some flare activity. AR3140 in the northeast is the second largest region, with a moderately sized mature spot, Hsx/Alpha. The only other moderately sized unipolar spot resides in the northwestern hemisphere, AR3135, a Hsx/Alpha. All other spots are relatively small and simple, AR3136 has faded to plage, and a new region continues in the southeast, currently a simple Bxo/Beta, though it has shown some signs of fading. No Earth-directed CME have been observed.

Solar Wind / Geomagnetic Activity: The solar wind, observed by DSCOVR at L1, has been generally slow-ambient with averages around 380km/s, and occasional increases to slightly elevated, with peaks around 40-420km/s. Density has seen a steady increase from below to above average. Total magnetic field strength, IMF, has been generally weak, but has seen an increase from around 07/0700UTC, reaching moderate levels with a peak of 14.72nT. The north-south component, Bz has varied weakly for much of the period, ranging from +3/-3nT, but from around 07/0700UTC has become more moderately negative, with a minimum of 13.73nT. Phi angle has been mostly positive (away from the Sun). Geomagnetic activity was observed to be at Quiet to Active levels (Kp 0-4).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES-16 has remained at background levels. High energy electron flux (greater than 2 MeV) at GOES-16 has remained at high levels, reaching a peak of 9.40e3 pfu at 07/0925UTC. Electron fluence levels have steadily risen to reach 5.68e8 integrated pfu at 07/1200 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to be generally Low, with a chance of Moderate activity.

Solar Wind / Geomagnetic Activity: Geomagnetic activity is expected to be mainly Quiet to Unsettled given generally slow-ambient solar winds, but there is a chance of Active intervals at times given any prolonged periods of negative Bz. There is a slight but increasing chance of G1/Minor Storm intervals due to the possible arrival of coronal hole high speed streams.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) observed by GOES-16 is expected to be at background levels. High energy electron flux (greater

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than 2MeV) is expected to continue at generally high levels much of the period. Electron fluence values are expected to remain above the Active (1e8 integrated pfu) threshold through the period due to elevated electron flux values, with a slight chance of reaching Very High (1e9 integrated pfu) levels later in the guidance period.

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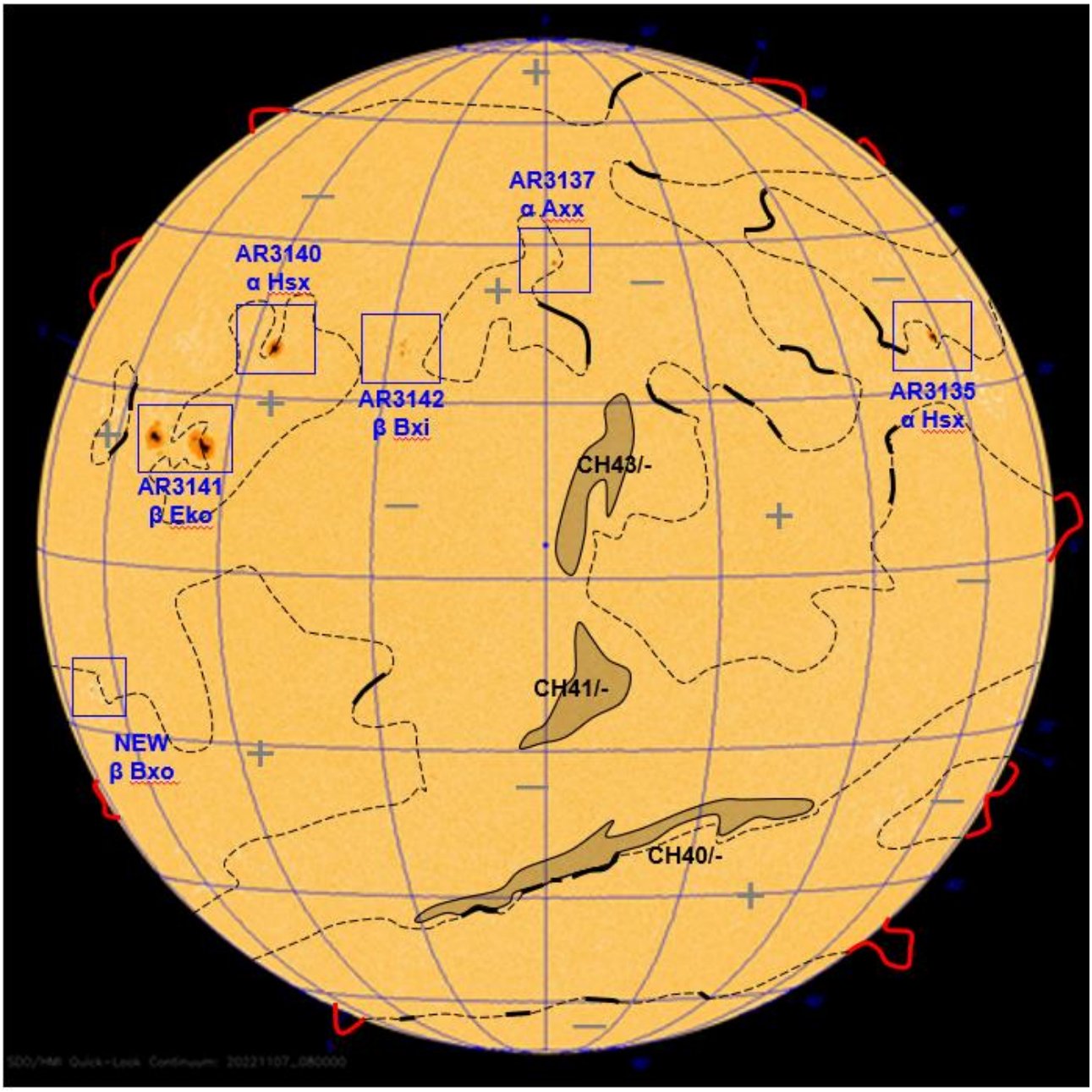
Figure 1. Solar Analysis Valid 07/0800UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx – Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth directed CMEs currently feature in the forecast.

Solar wind speeds are currently slow-ambient, with speeds averaging around 380km/s. Influence from the elongated Coronal hole 40 in the south of the disk may see an increase in speeds at times throughout the period as the leading edge becomes geoeffective, although there is low confidence in the strength of any connection. There is a higher chance that the Earth may connect to coronal holes 41 or 43 later on day 3 or into day 4 (9th or 10th Nov), however their impact on the Earth is expected to be fairly limited due to their negative polarity as we slowly edge away from the autumn equinox.

Geomagnetic activity is expected to be mainly Quiet to Unsettled, with a chance of Active intervals at times given any prolonged periods of negative Bz. There is a slight, but increasing chance of G1/Minor Storm intervals due to the possible arrival of coronal hole high speed streams.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	10	15	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity – Earthbound Coronal Mass Ejections

Nil.

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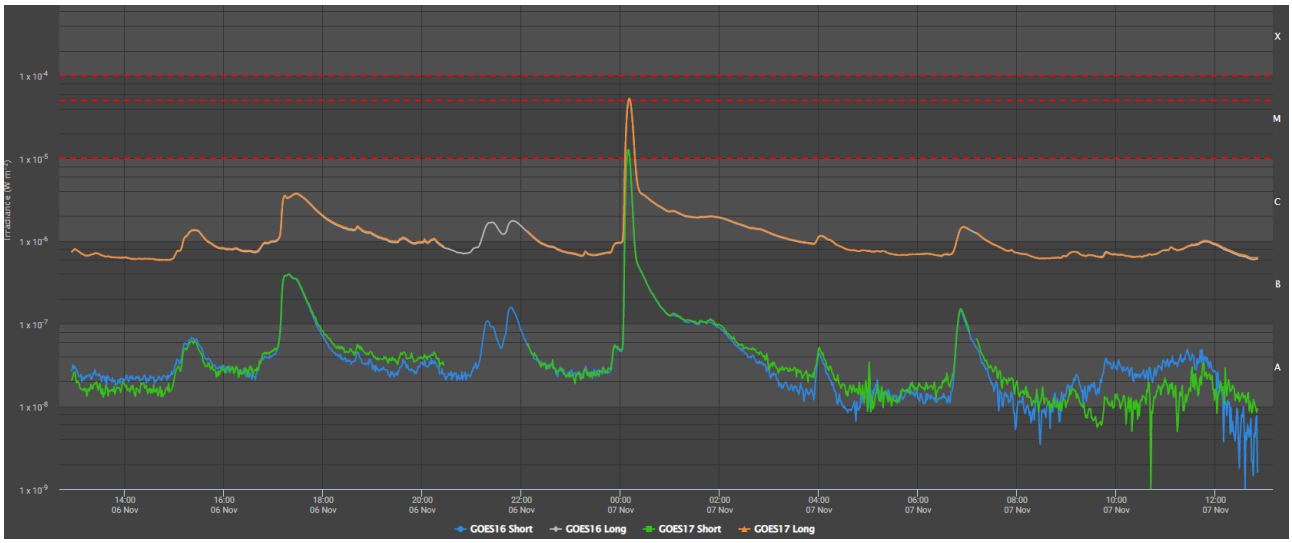
Radio Blackouts - X-Ray Flares:
There are five numbered and one unnumbered active regions on the visible disc. AR3141 in the east remains the largest and most complex region on the disk, classified Eko/Beta with a large leader and large trailing spot, this spot has shown some recent flare activity. AR3140 in the northeast is the second largest region, with a moderately sized mature spot, Hsx/Alpha. The only other moderately sized unipolar spot resides in the northwestern hemisphere, AR3135, a Hsx/Alpha. All other spots are relatively small and simple, AR3136 has faded to plage, and a new region continues in the southeast, currently a simple Bxo/Beta, though it has shown signs of fading. A further area of sunspot activity is expected to rotate onto the southeast visible disk by day 2 (8th Nov).

Solar activity has been Moderate, with several C-class flares observed in the past 24 hours, and at 07/0011UTC a single M-class flare was recorded originating from sunspot AR3141. Activity is expected to remain largely Low, but there is a chance throughout of further isolated M-class flares, most likely from AR3141 to start, giving Moderate solar activity.
There remains a very slight chance of isolated X-class flares and solar activity reaching High levels throughout the period.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	30	30	30	30
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 2: X-Ray trace showing activity over the last 24hrs.



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) at GEO, observed by GOES-16 is currently at background levels and is forecast to remain at this level through the guidance period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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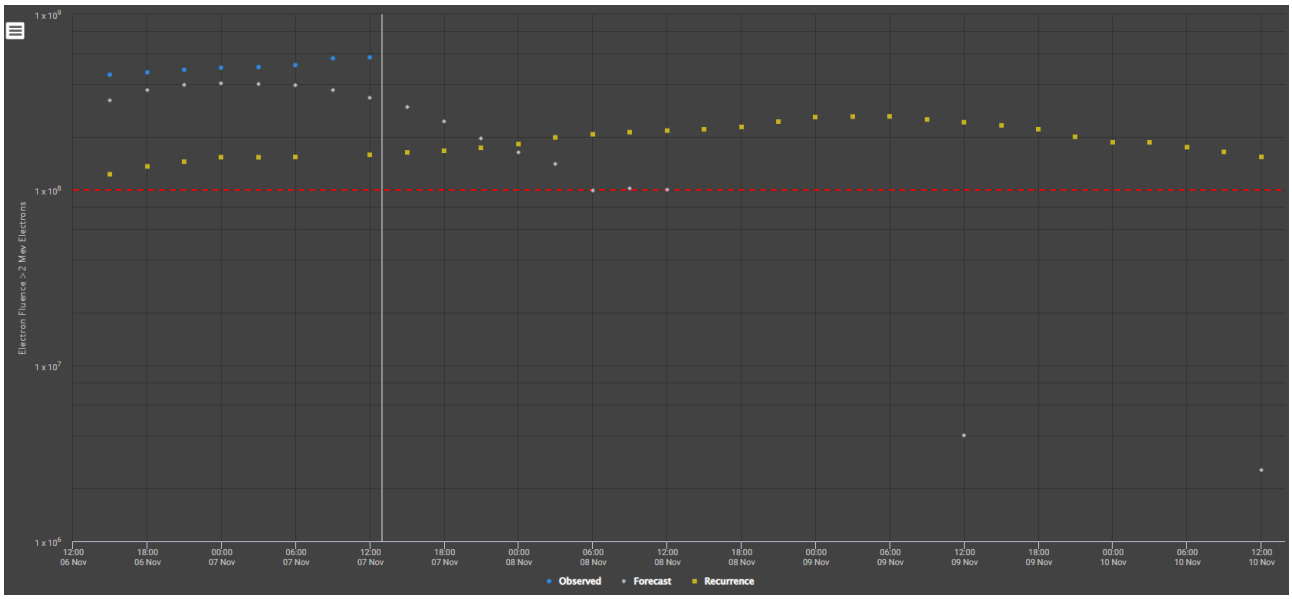
High Energy Electrons Event (≥ 2MeV):
The high energy electron flux (greater than 2MeV) has remained at high levels over the past 24 hours with this likely to continue as a result of the recent input into the radiation belts. These levels will probably be maintained for much of the coming guidance period given that no significant geomagnetic activity expected. Brief declines are possible, mainly due to diurnal variations, but these are unlikely to be sustained.

Electron fluence is also expected to remain above the Active threshold (1e8 integrated pfu) for much of the period. The risk is considered lower towards the end of the period simply due to reduced confidence in any geomagnetic activity and rate of electron losses in the radiation belts. There remains a slight chance of reaching Very High (1e9 integrated pfu) levels through the period.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	Yes	100	90	80	70
Very Active	≥ 2 MeV ≥ $1x10^9$	No	5	10	10	5

Figure 3: Current REFM model output showing observed values in excess of forecast.



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